Project NY 112 006-1
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technical note:

ANDERSON-NICHOLS END-TO-END CONNECTION FOR PONTOON CAUSEWAYS

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INTRODUCTION

Under a program to improve existing NL pontoon gear, an end-to-end connection for causeways was developed by Anderson-Nichols and Company, Boston, Massachusetts. The purpose of this connection was to provide a method of securing causeway sections end-to-end thus eliminating the overlapping of causeways as now required.

The design as developed embodies the use of curved pontoons (designated as T-7's) on the ends of each causeway string, with the T-7 pontoons in the offshore section placed in a normal or deck-up position, and the T-7 pontoons in the inshore section in an inverted or deck-down position. Flat wire straps, chains, and a hinged ramp constitute the end-to-end connection. The hinged ramp attached to the offshore section is to provide for the flow of traffic.

A causeway 14 feet wide by 350 feet long, using the end-to-end connection, was constructed and tested by the Laboratory under project NY 112 006-1.

CONSTRUCTION

Two 2x30 causeway sections were assembled in accordance with Y&D Dwg. No. 126,429 except that the inshore section was modified by inverting the T-7 pontoons on the offshore end.

The end-to-end connection (see Fig. 1) was fabricated in accordance with Anderson-Nichols Dwg. No. AA-D-780. Two flat wire ropes, 8 in. wide by 5/8 in. thick by 72 in. long from bearing to bearing, complete with poured sockets on each end, were fabricated to form a connection between the causeway sections. Open clevis brackets were cut from l-in. steel plate and welded to the outboard deck angles on one end of the offshore section as shown in Figure 2. Pin and clevis brackets were cut and welded to the outboard bilge angles at the ends of the inverted T-7 pontoons on the inshore section as shown in Figure 3. The sockets on the end of the flat wire rope connections to be attached to the bilge-angle pad eyes were of commercial design and manufacture, whereas the sockets for connection with the open clevis brackets were of a special steel ball-and-pin design as shown in Figure 1. In attaching the ball socket to the flat wire

rope, it was necessary to split open the ball, insert the rope, reweld the ball, and then pour the socket.

The 2-in.-diameter dredge chain specified for the connection was substituted with l-1/2-in.-diameter, cast-steel, anchor chain available from Laboratory stock. This substitution reduced the breaking strength of the chain by 37,000 lbs and the weight by 17 lbs per lineal foot. The chains were mounted, one on each side of the causeway as shown in Figure 4, by means of l-1/2-in.-diameter lang-lay wire rope pennants secured to each end of the chains and to the special steel bitts shown in Figure 5. In practice, the chains are designed to hang over the sides of the causeway to form catenarys, the end reactions of which pull the sections together.

The special steel bitts were secured by means of wedge-shaped pins and side plates to the outboard pontoon deck angles. The bitts, fabricated from 5-in.-diameter round stock and l-in.-thick steel plate, were made to fit 8-in.-wide pontoon angles. This necessitated placing the bitts three pontoons farther back from the end than was intended in the Anderson-Nichols design, since a 6-in.-wide angle is used to join the six end pontoons in a standard causeway section. In addition to holding the chain, the bitts were located so as to prevent the chain from rising onto the deck of the causeway when acting as a catenary. A saddle, designed to fit over each bitt, was formed from 4-in. steel square stock and l-in. steel round stock. Its purpose, as shown in Figure 6, was to support the wire-rope pennant and keep it lined up with the groove in the bitt holding the end of the pennant.

The steel ramp, hinged at deck level to the offshore section of the connection, was designed to ride on the curved portion of the inverted T-7 pontoons and form a bridge between the end of the causeway sections as shown in Figure 7. Steel side flaps, 2-1/2-in. thick and 18-1/2 in. long, were bolted to the outboard edges of the ramp with 2-in.-diameter steel bolts as shown in Figure 8. These flaps hang vertically over the outboard edges of the inverted T-7 pontoons and are free to rotate approximately 190 degrees. These were provided to limit the lateral movement of the causeway sections. The decks of the two causeway sections were not level with each other because of the added weight of the ramp on one section and the additional buoyancy obtained by inverting the T-7 pontoons in the other. The decks were made level by flooding the two inverted T-7 pontoons.

A chain locker was formed in the offshore end by enclosing a 9-in. space between two pontoons. The locker was constructed of l/2-in.-thick steel plate and provided with small holes for water drainage (see Fig. 6).

TESTS

All water tests were performed by a 12-man crew of Seabees from the Amphibious Construction Battalion One under the direct supervision of A.F. Kratsmeirer, SWC. Preliminary tests were conducted in the harbor at Port Hueneme in order to familiarize the personnel with the connection procedure.

The causeway sections were brought end-to-end by means of propulsion barges, and the ball sockets were lifted with the manila hand lines into the open clevis brackets on the pontoon deck angles. The catenary chains were lifted from the chain lockers and laid out on the deck as shown in Figure 9, the wire rope pennants were connected to the bitts, and the chains were dropped over the sides of the causeway. The 23-in.-long commercial sockets attached to the bilge-angle clevis brackets were too long and held the two causeway sections apart. New sockets, with an over-all length of 14 in., were fabricated from l-in. steel plate similar to the original socket but with a shorter loop opening and a shorter basket. The shorter lengths allow the two causeway sections to be closely joined.

Initial beaching tests in relatively calm water, with the connection previously made in the still water of the harbor, were made to acquaint personnel with the beaching procedure. During these tests the ball sockets on the flat wire rope would not remain in the open clevis brackets. Prior to making connection tests in the open sea, holes were drilled vertically through these brackets for inserting 3/8-in.-diameter keeper pins.

At sea it was not possible to make a connection in heavy swells estimated to be 5 ft from crest to trough. The ends of the sections were brought together, and the free ends of the flat wire rope connections were dropped and locked into the open clevis brackets. However, before an 8-man team could work the catenary chains out of the chain lockers and drag them across the ramps and complete the connection, the keeper pins used to lock the ball sockets in the open brackets sheared, the temporary tie lines broke, and the connection was lost in the sea.

The causeway was returned to the harbor, and the sections were connected and the ball sockets fixed in place by welding l-in.-thick steel keeper plates across the throat of each open bracket as shown in Figure 10. The causeway was towed to the beach site and beached with pontoon barges attached to the offshore section. Difficulty in steering the connected sections was experienced because the flexibility of the joint permitted the inshore section to weave. Beached in a surf having breakers of approximately 5 ft the connection was test-loaded by traversing it with a D-8 tractor as shown in Figure 11. During the 7-hour test the side flaps on the ramp were found to be too short to hold the sections in direct alignment at all times, and the side-flap connector bolts were bent by the continual riding of the flaps upon the curved sections of the inverted T-7 pontoons.

After completion of the beaching test, the side flaps were lengthened 12 in., the connector bolts were replaced, and the causeway connection was tested a second time for 5 hours in a surf with approximately 3-1/2-ft breakers.

In the second test a D-8 tractor was driven over the connection 16 times with no difficulty. Throughout the test the side flaps remained hooked over the edges of the pontoons, fair alignment between the sections was observed, and the catenary chains operated satisfactorily. An inspection of the parts after the second test disclosed that the sewing wires used to join the strands of the flat wire rope were completely worn out through continual rubbing between the curved surfaces of the pontoons; however, the actual load-bearing strands of the wire rope appeared only slightly damaged.

OBSERVATIONS AND CONCLUSIONS

Securing causeway sections end-to-end using the Anderson-Nichols connection could not be accomplished at sea. However, a causeway with the connection made in calm water is usable in the surf, although steering of the causeway onto the beach is difficult because of flexibility of the connection. During an attempted connection at sea, the ball sockets would not remain in the open brackets even when pinned, and the hinged steel ramps which were raised up and down by the vertical movement of the T-7 pontoons prevented placing of the catenary chains.

Using the Anderson-Nichols connection only minor modifications are necessary to the standard NL pontoon gear. Pontoons

normally required in making up a lap joint can be used in the length of the causeway; however, the connection does not allow for adjustment in varying the length of the causeway which is necessary when making a beach landing from ship to shore.

Traffic over the causeway is limited to one direction, whereas the lap joint can be used as a passing point for two-way traffic which is often required when unloading ships.

The steel ramps bridged the gap satisfactorily between the causeway sections, and lengthening the side flaps prevented them from riding up onto the inverted T-7 pontoons. By keeping these flaps hooked over the edges of the pontoons lateral alignment was maintained between the causeway sections.

The sliding action between the curved ends of the pontoons at the joint completely wore out the sewing wires used to join the strands of the flat wire rope.

The ball sockets attached to the upper ends of the flat wire ropes were difficult to fabricate, and the ball shape does not meet the standard requirements for making a poured wire rope joint, resulting in loss of strength to the joint.

The chains were stored in the chain lockers by double flaking because this method permits both ends of the chain to be withdrawn simultaneously. Eight men are needed to remove the chains from the lockers and complete the connection.

FUTURE PLANS

Tests will be made to establish a procedure for joining the causeway sections in the open sea. Prior to these tests, the ball sockets will be redesigned to simplify construction and assembly. An open clevis bracket will be designed and fabricated to permit quick attachment and locking of the ball socket without the aid of keeper plates. The steel bitts will be modified to fit the 6-in. pontoon angles in order to use the shorter lengths of catenary chains specified by Anderson-Nichols and Company. Studies of modifications to the steel ramp and side flaps are being made in an attempt to facilitate coupling of the ball sockets into the open brackets.

Future plans also include studies of two new designs for an end-to-end connection devised by the Laboratory.

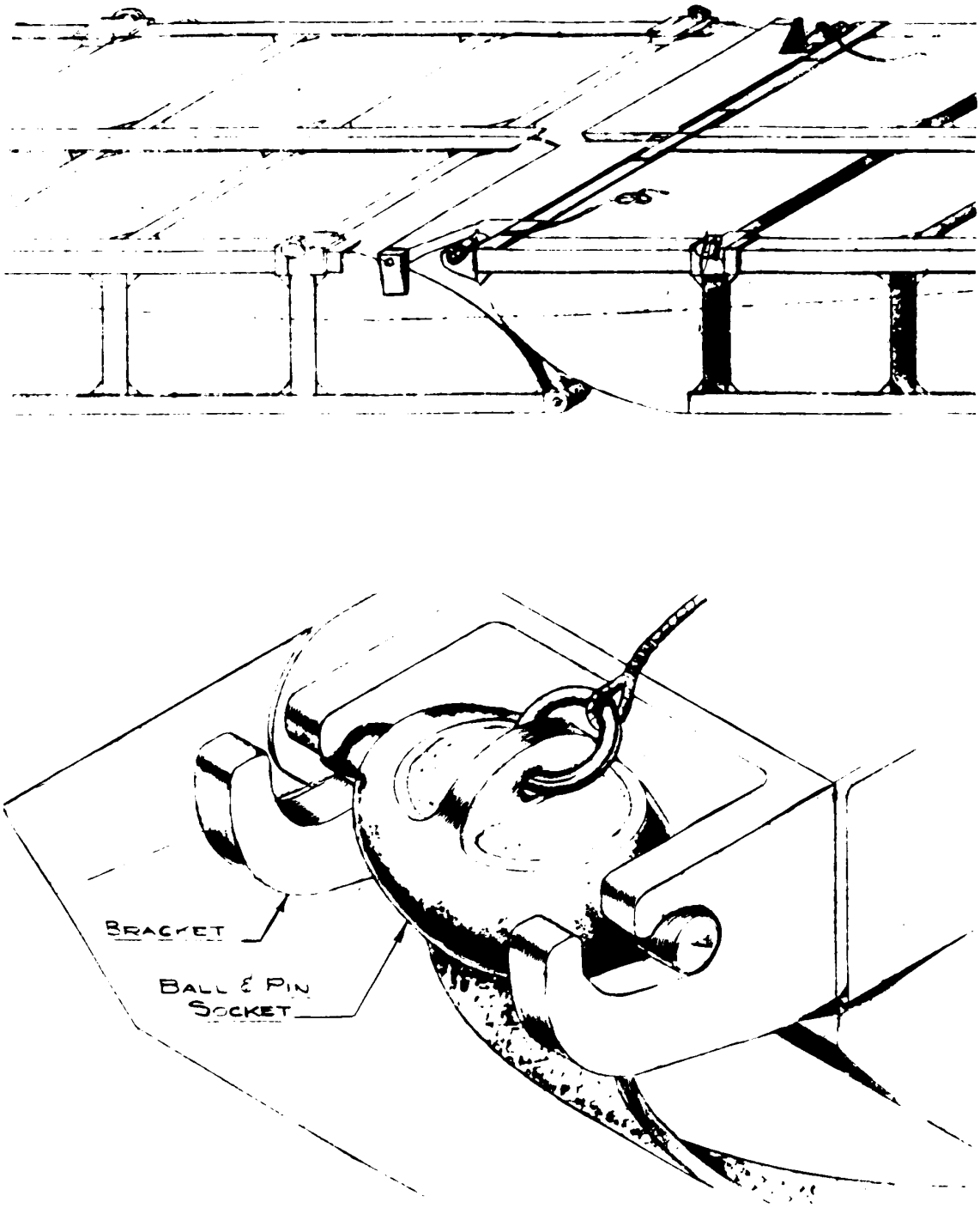

Figure 1. Anderson-Nichols end-to-end pontoon causeway connection.

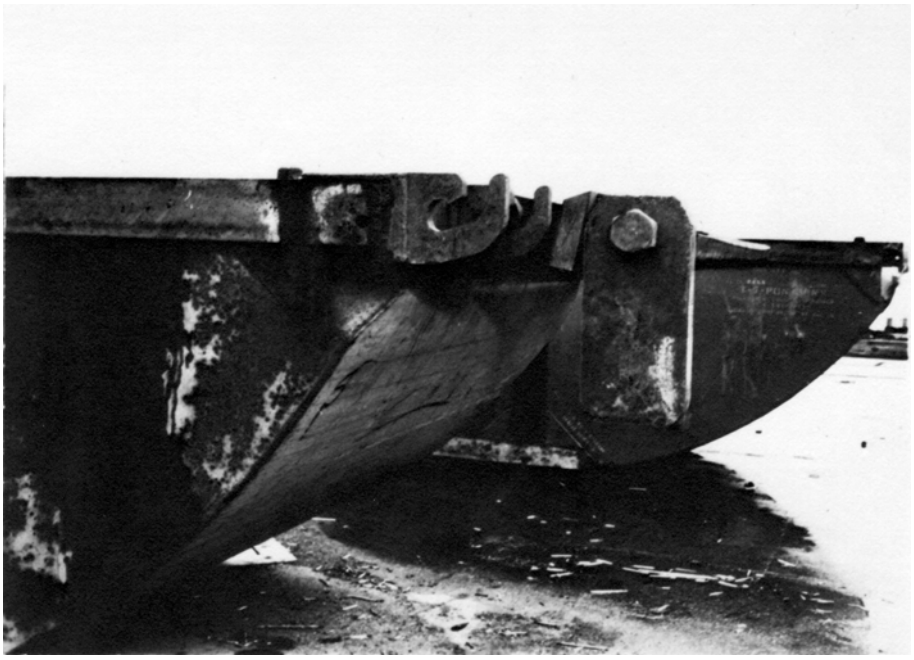

Figure 2. Open type pad eye which receives free end of flat wire rope connection, welded to one end of outboard angle of offshore causeway section

Figure 3. Pin type pad eye, for securing fixed end of flat wire rope connection, welded to bilge angle on inverted T-7 pontoon end of inshore causeway section.

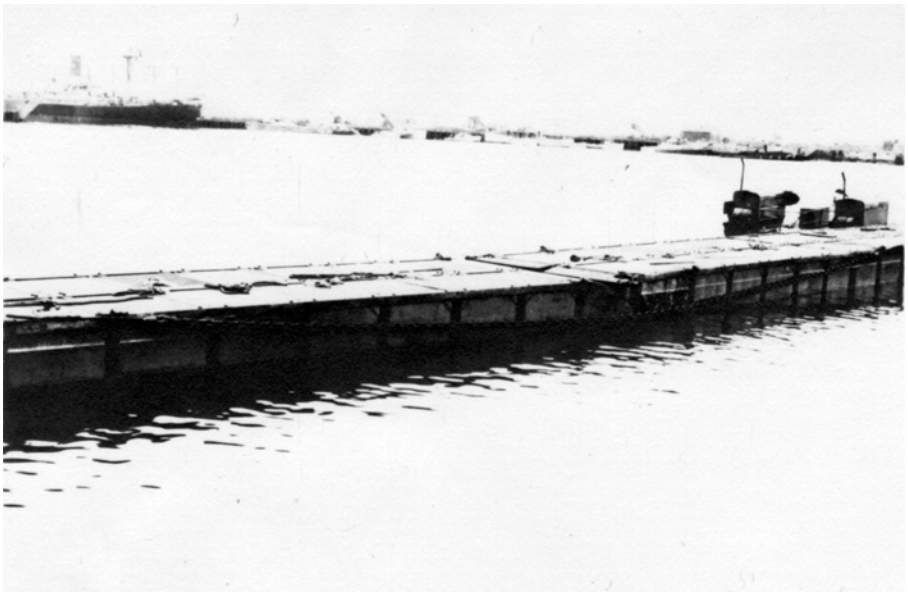

Figure 4. Sections attached end-to-end and catenary chains in place.

Figure 5. Special bitt fabricated from structural shape for use in pulling sections together and attaching catenary chains.

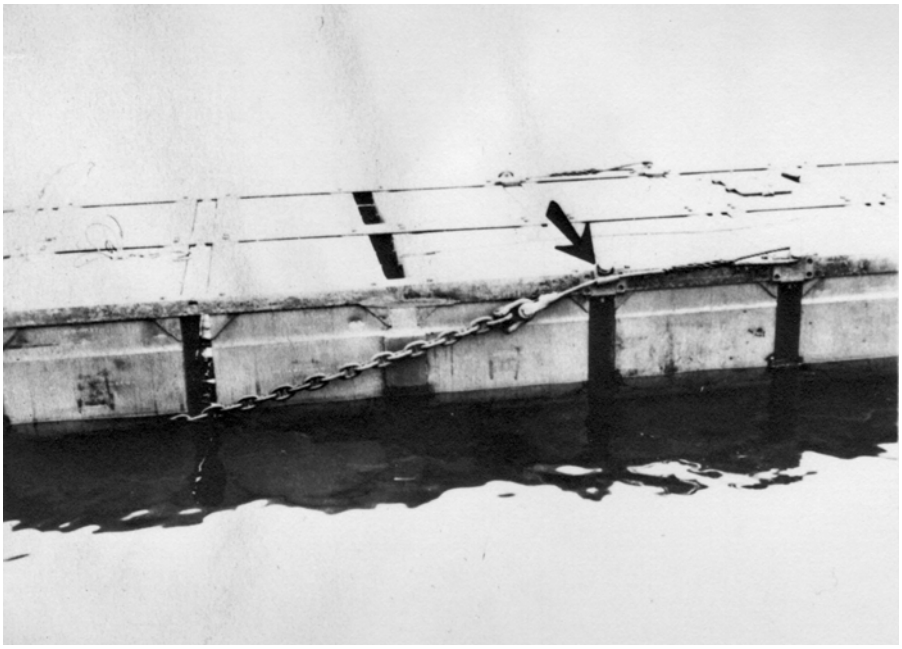

Figure 6. Arrow indicates saddle placed over bitt. It is used to support the wire rope pennant. Note the chain lockers denoted by opening in deck between pontoons.

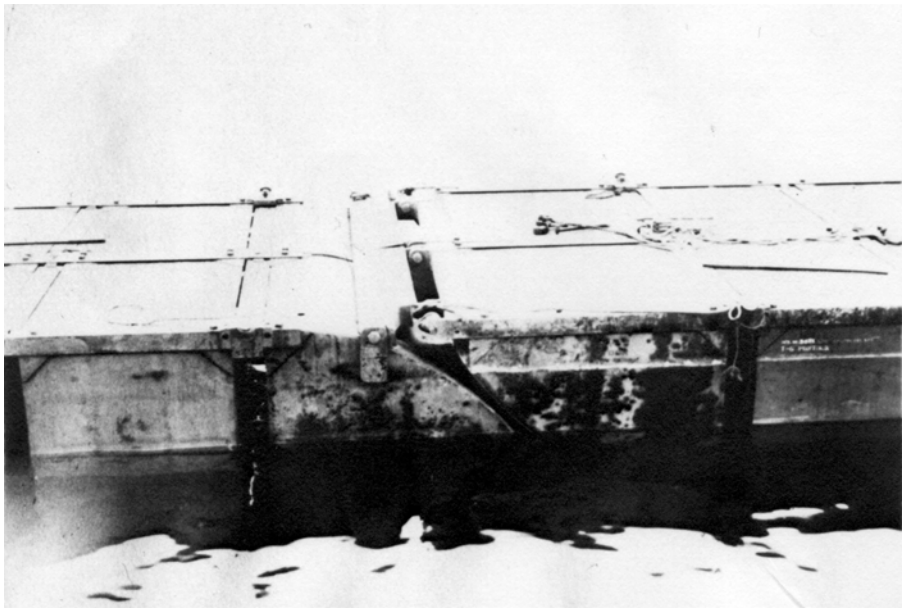

Figure 7. Ramp provided for traffic flow. Hinged to offshore section, the ramp rides on the inverted T-7 pontoons of the inshore section.

Figure 8. Steel side flap bolted to the pontoon ramp.

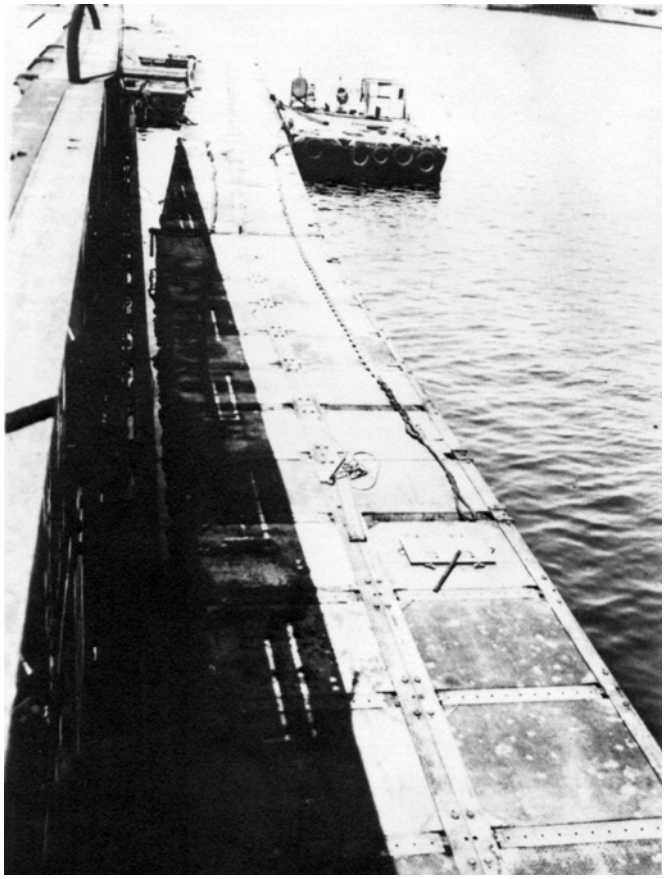

Figure 9.

Catenary chains laid out on deck during calm water connection tests.

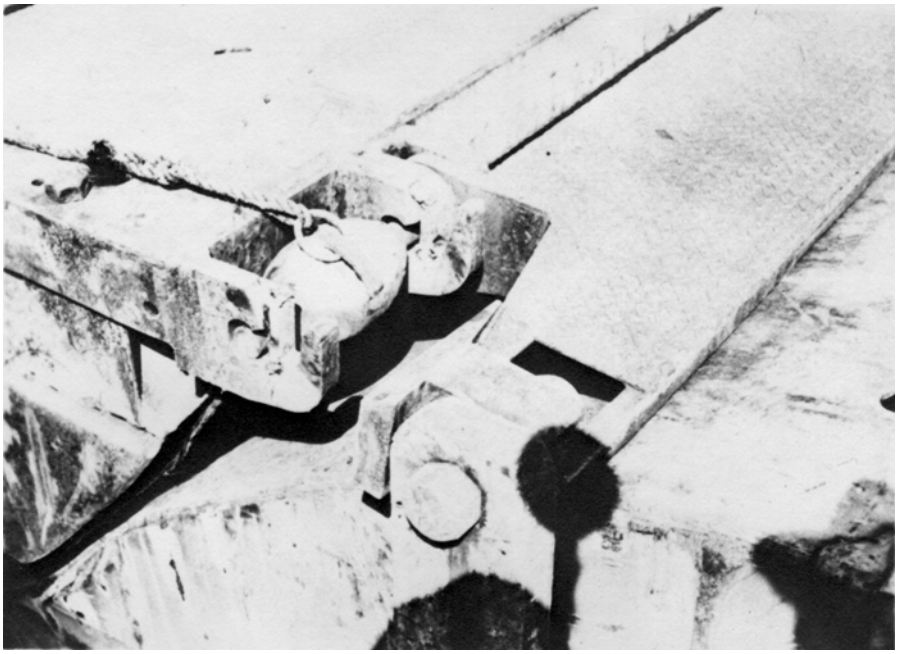

Figure 10. Ball sockets fixed in place in the open clevis brackets with welded steel keepers.

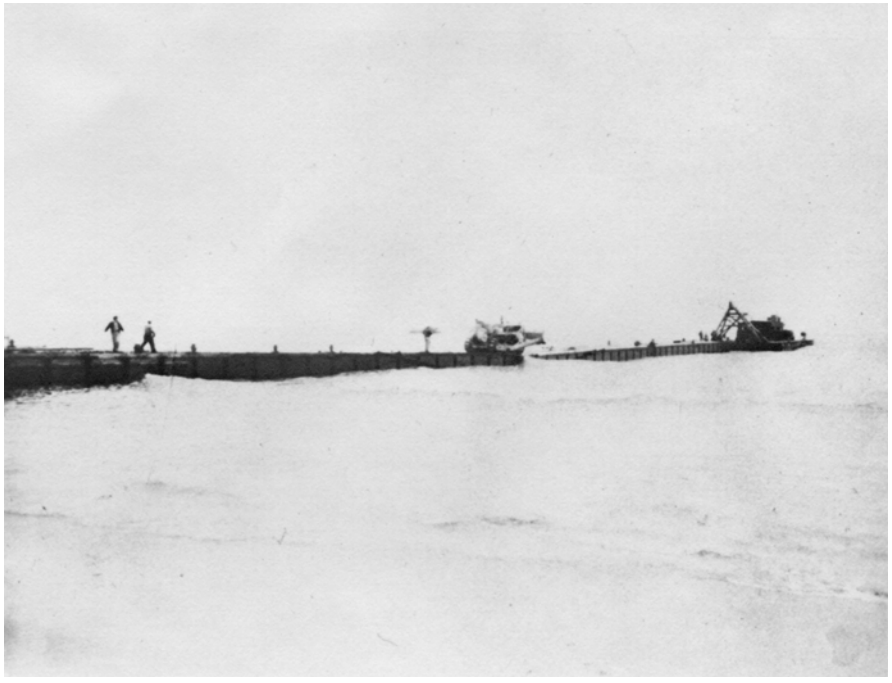

Figure 11. Testing the end-to-end connection in 5-ft surf with a D-8 tractor.